# TUNNEL CENTRAL CONTROL SYSTEM

## SECTION 3

## TECHNICAL REQUIREMENTS

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# SECTION 3 TECHNICAL REQUIREMENTS

This section defines the technical requirements to be met by the successful Proposer.

## 3-1 I-90 TCCS ARCHITECTURE

A. The TCCS is defined as the system of computers, networks, communication interface equipment, software and databases that provide supervisory control of the tunnel systems. The "I-90 TCCS System Diagram" in Appendix T-1 shows the major hardware components of the TCCS and the tunnel subsystems that it communicates with. Proposers are encouraged to propose configurations that achieve the flexibility and reliability described in this RFP. WSDOT owns and operates an extensive wide area network based on Microsoft Windows Server and Workstations. This section of the RFP represents the preferred architecture that WSDOT is most able to support. However, Proposers may identify alternative architectures and technologies that fulfill the functional requirements. During the evaluation phase, alternative technology proposals will not be penalized on technical grounds for not selecting the specific preferred technologies (though functional issues still apply), however the Proposer must include an itemized list of deviations and also include the cost to contract support for any systems that deviate from the preferred architecture. Proposals will be evaluated based on total cost including support for ten (10) years. (See Section 5-1.3, Acceptance and Exceptions to the RFP)

B. The TCCS shall be setup as a Microsoft Domain with Windows 2000 Active Directory (AD). The MBT and FHL control rooms shall have an on site domain controller. The Contractor shall work with WSDOT Network Administration to build trust relationships between the existing WSDOT AD and the new control room domain. The end result shall provide WSDOT with the ability to monitor and control all computers and network devices at MBT and FHL from the existing WSDOT Domain. WSDOT desires to administer user accounts and to control and maintain Servers from existing computers within the WSDOT Domain.

C. The Contractor shall build private networks to communicate with the various tunnel communication interfaces, i.e. PLCs, Telephone Switch, etc. The private networks should use fixed non-routable IP addresses. Unsecured devices shall not be connected to the existing WSDOT WAN. Server computers shall communicate with the tunnel devices on the private networks.

D. Data and logging functions shall store data on MS SQL Servers. The MS SQL Servers shall replicate all data, logs and records on each Server. There shall be a minimum of three MS SQL servers; one shall be installed at each control room and one at Dayton Avenue.

E. All printing shall be via print queues on the tunnel servers and any other print queue on the existing WSDOT network.

F. Servers shall communicate with tunnel devices and Workstations. All Servers and server functions shall be redundant. It shall be possible to shutdown any one Server machine and not disrupt the polling of Traffic Data Stations, CO detectors or any other tunnel system. Loss of a single Server shall not cause loss of data collection or storage. Servers shall supply the current tunnel operation parameters and data to each Workstation upon successful login. At the MBT and FHL locations one or more Servers shall perform the following tasks;

1. Tracking active Workstations and Servers

2. Perform any necessary IP address assignment to Workstations and Servers (DHCP), however DHCP assignment must be coordinated with existing WSDOT infrastructure

3. Provide SQL database services and data archiving

4. Perform user (operator) authentication

5. Process and log command and status requests from Workstations

6. Provide protocol conversion between the Workstations and tunnel devices

7. Provide central location for Workstation software updates

G. Every control action and all errors, including automated events, shall be recorded to logs on the SQL servers. As a minimum, the records shall contain the following information;

1. Time and Date

2. User account name

3. User full name

4. Computer name and location that requested the action

5. The action being requested (moving camera, changing fan speed etc.)

6. Any errors generated by the requested action

H. Workstations shall connect to Servers over the network. The Servers shall support a minimum of 16 concurrent Workstation connections. Turning off any or all of the Workstations shall have no effect on the operation of the tunnels. Data collection and control shall be independent of the Workstations. Workstations shall load all TCCS software, configuration data, and screen layouts from Servers in MBT and FHL. Hardware locks or other security means shall be deployed on the Workstations to restrict access to the TCCS Workstation software.

I. Workstations shall run a standard WSDOT Microsoft Office 2000 Pro installation concurrently with all TCCS functions. The Office 2000 applications will be run on the second monitor while the TCCS software is running on the primary monitor. WSDOT will provide the standard Office 2000 load, including license.

J. Security shall use Active Directory to verify users and account information. The TCCS software shall also use the same Active Directory account information to verify operator access rights. Communications between the Workstations and Servers shall be encrypted and secured. Communications between the Servers and the tunnel devices (on the private network) does not require encryption. The Proposal shall address the following security issues;

1. Prevent unauthorized access

2. Prevent the operation of stolen Workstation software.

3. Prevent spoofing of Workstation operations across the WSDOT WAN.

4. Limit access to the Active Directory information to authorized administrators.

5. Allow remote access to the TCCS using the WSDOT's RSA encrypted private tunnels.

### 3-1.1 Network Configuration

A. The TCCS network shall communicate via the existing WSDOT ethernet network. The Contractor shall design, install and configure any additional network equipment required by the design. The addressing, routing and other parameters of the networks shall be coordinated with WSDOT Network Administration. The local networks shall be connected to Dayton Avenue via WSDOT's existing wide area network (WAN). The WSDOT WAN currently operates at 100 Mbits. The local network at each tunnel shall continue to operate even if cut off from the WAN. The "stand alone" operation requires that addressing, security, logging, printing, accounting and all other mission critical functions be supported at MBT and FHL.

B. All Workstations and Servers shall connect to 100 Mbps network switches. Contractor shall provide 10 or 100 Mbps connections for other devices on the network.

C. The operating system for all Workstations shall be Windows 2000 professional or new WSDOT approved Microsoft Windows operating system. The operating system for all Servers shall be Windows 2003 Server. The network shall be configured as an Active Directory Domain.

D. The TCCS network protocols shall use standard Microsoft compatible TCP/IP networking.

E. The Contractor shall design and configure the TCCS for maximum reliablity. All local TCCS functions at each facility shall remain fully available if the WAN connection to Dayton Avenue is lost.

### 3-1.2 Equipment

A. TCCS equipment is identified in Appendix T-1, T-6, and T-7.

B. The WSDOT owns, maintains, and operates a wide area network (WAN) that encompasses both tunnel control rooms and the Dayton Avenue Building. All new TCCS computers and networking components shall be integrated into this existing network.

C. The existing network uses routers and high-speed switches manufactured by Cisco, Inc and Enterasys. All new networking equipment shall be manufactured by Cisco or Enterasys and shall integrate into the existing remote network management system.

D. All computer and network equipment shall be rack mounted in 19inch EIA bays including, servers, workstations, routers, switches, other network equipment, terminal servers, and processing and electrical conversion equipment. The Puget Sound Region is within an active earthquake zone and the proposal shall specify how the design provides for continued operation during and after an earthquake.

E. All equipment shall include a minimum three year manufacturer warranty.

F. All equipment shall be rated (by the manufacturer) for continuous 24-hour operation. WSDOT will give a preference to proposals using equipment with redundant, hot-swappable (online replacement) components.

#### 3-1.2.1 Workstations

A. The following Workstations shall be provided:

| Control Center Site | Workstation Function | Number of Workstations | Number of Monitors per Workstation |
|---|---|---|---|
| Dayton Avenue | Operator | 2 | 2 |
| Dayton Avenue | Maintenance/ Training | 1 | 1 |
| Dayton Avenue | Administrator | 1 | 1 |
| Mount Baker | Operator | 2 | 2 |
| Mount Baker | Maintenance | 1 | 1 |

| | | | |
|---|---|---|---|
| Mount Baker | Training | 1 | 2 |
| First Hill Lid | Operator | 2 | 2 |
| First Hill Lid | Maintenance | 1 | 1 |
| First Hill Lid | Training | 1 | 2 |

B. Workstations shall be supplied with Microsoft Windows 2000 Professional operating system. All hardware that comprises a Workstation shall be listed on the Microsoft Windows Hardware Compatibility List (WHCL) for Windows 2000 and Windows XP (Professional). The software licenses and warranty shall be recorded with WSDOT as the owner. Any workstation that performs server type functions shall be supplied per the Server requirements of this RFP. Servers are defined as any machine that cannot be turned off or on without transferring security, polling, logging, archiving, routing functions or any other mission critical function.

C. All Workstations shall be new and of current manufacture. Workstations shall be rated for 24-hour continuous operation and include redundant cooling fans and power supplies. All processors and all disc drives (including DVD/RW) shall be installed by the computer manufacturer. The Workstations shall be rack mounted in a vertical space not to exceed 4 EIA rack mount units (7 inches).

D. All Workstations shall be supplied with Intel Pentium 4 or Xeon processors (1 or 2 as required). The processor clock speed shall be 2 GHz or greater. The computer shall contain a minimum of two SCSI disc drives of 38 gigabyte or larger in a RAID 1 or 5 configuration. The computer shall also contain a DVD R/W drive of 8X or faster speed in any mode. Workstations shall be equipped with a minimum of 512 MB of RAM. The computer shall continue to operate in the event of a failed cooling fan or disc drive.

E. The Workstations shall be protected to prevent accidental operation of the reset switch, disk access and power switch of the computers.

F. Each Workstation shall be supplied with at least one monitor, keyboard, and mouse. The monitor, keyboard, and mouse shall be per Workstation Monitor, Workstation Keyboard, and Workstation Mouse. If the Workstation is intended for use from an equipment bay, the monitor, keyboard, and mouse functions may be shared with other machines in the bay using a Keyboard Video Monitor Mouse switch (KVMM).

G. All Workstations shall be equipped with a dual port video card. The video card shall support two or more monitors as separate and as unified desktop work areas. The cards shall contain a minimum of 64 megabytes of RAM.

H. All Workstations shall be equipped with sound cards or built-in sound support for Microsoft Windows. USB is the preferred connection technology for the speakers.

I. Speakers integral with each Workstation monitor are preferred by WSDOT. If this is not possible, supply one set of speakers with each Workstation. The speakers shall include a volume control accessible from the front of the speaker.

J. Each Workstation shall be equipped with a 10/100/1000 BaseT network card. The state has standardized on cards manufactured by the 3Com Corporation.

### 3-1.2.2 Server Computers

A. All computers that perform security, polling, logging, archiving, routing, or other mission critical functions shall be defined as Servers and meet the requirements of Server Computers. WSDOT uses servers from the Hewlett Packard ML 300 series. WSDOT perfers to use HP ML 370 Servers. WSDOT uses HP Insight Manager to remotely monitor servers. WSDOT uses MS System Management Server and Dameware to remotely manage servers. The Proposer shall identify the proposed equipment and discuss how they intend to integrate the new equipment into WSDOT remote management systems.

B. Servers shall be supplied with Microsoft Windows 2003 Server operating system. All Server hardware shall be listed on the Microsoft Windows Hardware Compatibility List (WHCL) for Windows 2000 and 2003 Server. Servers shall be supplied with sufficient client licenses for all Workstations. The software licenses and warranties shall be recorded with WSDOT as the owner.

C. All Servers shall be new and of current manufacture. Servers shall be rated for 24-hour continuous operation and include redundant, hot swappable cooling fans and power supplies. All processors and all disc drives (including CD) shall be installed by the computer manufacturer. The Servers shall be designed for rack mounting in a vertical space of no more than 8 EIA rack mount units (14 inches).

D. All Servers shall be supplied with Intel Xeon processors (1 or more as required). The processor clock speed shall be 2 GHz or greater. The computer shall contain a minimum of four SCSI disc drives of 38 gigabyte or larger in a Hardware RAID 5 configuration. The computer shall also contain a CD drive of 8 times speed or faster in any mode. Servers shall be equiped with a minimum of 1.0 gigabyte of RAM. The computer shall continue to operate in the event of a failed cooling fan, power supply or disc drive.

E. The Servers shall be protected to prevent accidental operation of the reset switch, disk access and power switch of the computers.

F. Each Server shall be connected to a monitor, keyboard, and mouse. The monitor, keyboard, and mouse shall be rack mounted and supplied by the same manufacturer as the Server. The monitors shall be rack mounted TFT flat screens with a resolution of 1024 by 768 pixels or greater. Servers that are contained within the same equipment bay may share the monitor, keyboard, and mouse with other machines in the bay using a Keyboard Video Mouse switch (KVM). In the event that KVM switches are supplied, the switches shall use on-screen displays and select the active machine via the keyboard.

G. Each Server shall be equipped with a video card. The video card shall support a minumum 1024 by 768 pixel video resolution. The cards shall contain a minimum of 8 megabytes of RAM.

H. Each Servers shall be equipped with a minimum of 2 USB Version 2 ports.

I. Each Server shall be equipped with one or more 10/100/1000 BaseT network cards as required. The state has standardized on cards manufactured by the 3Com Corporation.

### 3-1.2.3 Workstation, Server and Process Computers and Equipment

A. All Workstation, Database and process computers which make up TCCS shall be colored as follows:

1. Tunnel room monitors, keyboards and mice shall be black

2. Dayton Avenue monitors, keyboards and mice shall be white

3. To the extent possible the colors should match the surrounding equipment and surfaces

### 3-1.2.4 Workstation Monitors

A. Workstations monitors shall have the following minimum characteristics:

1. Use LCD TFT technology

2. 18.1” (diagonal) screen

3. 1600 by 1200 pixel resolution

4. Contrast ratio of at least 300:1

5. Viewing angles of at least 70 degrees horizonally and vertically

### 3-1.2.5 Workstation Keyboard

A. Each Workstation shall include a keyboard.

B. The keyboard shall be provided with a wrist rest, and a cable of sufficient length to be positioned directly in front of the monitor(s).

C. The Keyboard shall be a 101-key compatible US Keyboard with an USB Interface.

### 3-1.2.6 Workstation Mouse

A. Each Workstation shall have a Microsoft USB Optical Wheel Mouse.

### 3-1.2.7 Printers

A. TCCS shall include a report printer at the control room at MBT, FHL, and Dayton Avenue.

B. Each printer shall use laser technology and be new and of current manufacture.

C. Each printer shall print duplex (two-sided).

D. Each printer shall have at least 32 megabytes of memory.

E. Each printer shall print at a minimum 600 x 600 dots per inch and 20 pages per minute.

F. Each printer shall include input paper trays that hold at least 250 sheets of 8½ - inch x 11- inch and 8½ - inch x 14- inch (legal) paper.

G. Each printer shall connected to the LAN using 100 BaseT Ethernet and be configured for direct TCP/IP printing.

### 3-1.2.8 Network Time Protocol Source

A. WSDOT will provide a network time source. The source maybe an Internet time source or a time source on an existing network router or server.

### 3-1.2.9 Storage

A. Storage devices on Workstations and Servers shall use hardware RAID 1 or RAID 5 as required.

B. Workstation storage shall have at least twice the capacity needed for the TCCS functionality, including historical data for ninety days.

C. The Servers shall have at least twice the capacity needed for their functionality, including all historical event, traffic and alarm data per Section 3-5 for four years.

### 3-1.2.10 Uninterruptible Power Supply

A. TCCS will use existing uninterruptible power supplies to support all TCCS units at each site.

### 3-1.2.11 Rack Mounting

A. All equipment such as the Workstations, Servers, processors and network equipment shall be rack-mounted in the Control Room areas on 19 inch EIA standard mounting rails in equipment bays to be provided under the Contract.

B. The equipement bays shall be floor mounted with a nominal height of at least six feet and at most seven feet. Equipment bays contruction and color much match the existing equipment bays at each location..

C. The bays shall have a clear front door and a ventilated rear door. The doors shall be equipped with locks. Equipment bays shall be bolted to the concrete floor.

D. Bays shall have EIA standard drilled, tapped mounting holes.

E. Bays shall be equipped with screw clamp connection for grounding. TCCS equipment shall be grounded to the existing grounding system.

F. Bays shall be labeled with phenolic tags with the identification numbers or names approved by WSDOT.

### 3-1.2.12 Network Equipment

A. Network Switches shall be Cisco Catalyst 3550 with appropriate uplink interfaces.

B. All network equipment shall otherwise conform to WSDOT standards.

### 3-1.2.13 Cabling

A. All network cabling shall be Avaya GigaSpeed, Cat 6 Level 7. All cables shall be plenum rated.

B. All network jacks shall be by Avaya and shall be Avaya GigaSpeed.

### 3-1.3 Console

A. The Contractor shall provide a Console at MBT and at FHL for mounting one of the TCCS Workstations.

B. The Console shall be as shown in the drawing in Appendix T-7. It shall include:

1. A desktop section.

2. Towers to house existing equipment for annunciator and fire management computer.

3. Cabinets beneath the top for Workstation processors, pull-out EIA rail mounts and cable management.

4. Covers for cabinet areas the beneath top.

5. Plug mold strips with at least 18 outlets.

6. Monitor mounts with variable positions (Humanscale M-7 or approved equal)

7. Wood-trimmed edges or approved equal.

8. A 18.1" (diagonal) CCTV monitors with LCD TFT technology, color, VESA mounting, and EIA RS170 composite video via a BNC connector.

### 3-1.4 Spare Units

A. The Contractor shall provide one spare of each type of equipment. Including a complete workstation and complete server.

### 3-1.5 Software

A. TCCS shall be provided with high level tools for database definition, display definition, algorithms

B. TCCS shall be provided with a programming language for custom development, preferably C++.

C. TCCS shall be provided with database access tools for Historical Data, preferably MS SQL 2000

D. TCCS shall be provided with an automatic install disk(s) for every server and workstation configuration. This disk shall install any additional needed software.

### 3-1.6 Environment

#### 3-1.6.1 Space

A. The Contractor shall manage the available space within each of the control rooms to enable system testing, parallel operation of TCCS and the existing VAX-based tunnel control system, and the relocation of equipment units to their final destination.

B. See Appendix T-6 for the available spaces.

#### 3-1.6.2 Power

A. The Contractor will have up to 40 KVA (120 vac) of spare capacity for TCCS equipment supplied under the Contract at each location.

B. The Contractor shall furnish and install new circuits within the existing power panels in the control room to serve TCCS requirements.

#### 3-1.6.3 Access

A. Each control center rooom is on a raised floor. The Contractor shall run all cabling below the raised floor at each site

B. The Contractor shall run cables through existing cable trays where possible

C. See Appendix T-6 for approximate location of existing cable trays.

## 3-2 INTERFACE DISPLAYS

### 3-2.1 Navigation

A. The TCCS shall provide a conveniently navigated set of windowed displays for monitoring, control, and maintenance of tunnel systems. Complete navigation of the displays shall be possible using only the keyboard or only the mouse. A menu at the top of the screen shall always be visible for selecting the desired display. Access to primary displays shall be available through F keys on the keyboard. Pop-up displays shall be opened by clicking on icons representing equipment on overview displays.

B. The existing systems at the MBT Facility and the FHL Facility are separate. This upgrade shall combine the functionality of these two systems into a single, unified application operating on combined networks. The end result shall be that a person at any TCCS Workstation at any of the three control centers shall have full access to all TCCS functions for either tunnel. However, the display navigation shall be designed so that the user operates in the MBT display space or in the FHL display space. Switching operation to the other facility shall be by

deliberate action. Displays shall use distinctive background colors and other graphical differences to make it obvious to the user which tunnel is being presented.

C. The TCCS shall provide context sensistive help (including checklists) corresponding to the current activity or screen.

### 3-2.2 Colors

A. The normal background color for displays is black

B. Colors and blinking on displays shall be consistent with the conventions used on the existing displays. Contractor shall use these conventions as the basis for development of consistent color standards for the new displays.

C. Running or opened status is green. Stopped or closed is white-outlined. Alarm conditions is shown with red background for severe conditions and with yellow for warning conditions.

D. Signal head icons shall be the same color as the actual signal lamp illuminated: red, amber, green or black for none.

E. Icons for traffic speed status uses flashing red for very low; red for low; amber for medium; and green for high.

F. Icons for traffic occupancy uses flashing red for very high; red for high; amber for medium; and green for low.

G. Light blue shall be used to indicate that the system or component is manually offline or out of service or unavailable to use.

H. Icons and graphical elements on power screens shall use: purple for utility power; yellow for generator power; and white for unpowered.

I. Camera icons shall be purple when the camera is selected.

J. Graphical elements with an associated warning alarm shall display the state of the alarm consistent with the standard color definitions: green when normal and reset; flashing amber / black when unacknowledged and in alarm; steady amber when acknowledged and in alarm; and flashing amber / green when normal but not reset. For example, the fan running/off status colors shall be apparent even if the fan has an active warning alarm.

K. Graphical elements with an associated regular alarm shall be: green when normal and reset; flashing red / black when unacknowledged and in alarm; steady red when acknowledged and in alarm; and flashing red / green when normal but not reset.

L. Alarm text messages for all alarms shall be: red when unacknowledged; amber when acknowledged; green when normal but not reset. All disabled alarms shall be in white text.

## 3-2.3 Displays

### 3-2.3.1 General

A. The Contractor shall include whatever displays are necessary in order to provide the required or necessary functions of the TCCS. The following is a list and description of the minimum required displays for a single tunnel facility. That is, each display itemized below shall require two actual displays – one for MBT and the other for the FHL. The Contractor may use the existing displays to clarify questions about functionality, but they are not intended as the design basis for the new displays. The Contractor shall develop new icons and symbols as necessary to support the required functions.

### 3-2.3.2 Tunnel Geographic Displays

A. These displays are intended to provide a higher level overview of multiple tunnel systems. Each of these displays shall use a background showing the contour of the tunnel roadways. Icons representing each of the various devices along the roadway such as phones, cameras, or signal heads shall be placed to locate the device where it exists along the roadway. In general the icons may be clicked on to open fully detailed pop-up control displays with information, status and control options for the equipment. Addional icons shall give immediate access to each of those graphic displays. The tunnels shall be in a geographic representation as indicated in Appendix T-4.

#### 3-2.3.2.1 Main Overview

A. The Main Overview display shall show all systems including signs, signal heads, fire zones, phones, cameras, traffic and lighting. It shall provide similar detail level to the existing “Master Screen” shown in Appendix T-3, excluding ventilation fan status.

#### 3-2.3.2.2 Fire Overview

A. The Fire Overview display shall show detailed fire system status for all three roadways. It shall also include cameras, phones, signs, and traffic direction indicators. It shall provide similar detail level to the existing “Fire Screen”, as shown inAppendix T-3.

#### 3-2.3.2.3 Traffic Overview

A. The Traffic Overview display shall show detailed portal sign, signal head status and all traffic data. It shall provide similar detail level to the existing “Signs & Signal Heads”, “Traffic Screen” and “Traffic Data Stations” displays, as shown in Appendix T-3.

### 3-2.3.3 System Displays

A. These displays show a particular system graphically as a functional arrangement of the components.

#### 3-2.3.3.1 Power System

A. The Power System display shall show an electrical one line diagram of the power system at the facility. It shall provide similar detail to the existing “Power” display, as shown in Appendix T-3.

#### 3-2.3.3.2 Ventilation System

A. The Ventilation System display shall show all supply and exhaust fans arranged in order relative to the arrangement of the fans in the each tunnel roadway. It shall include all status and mode details of the existing fan displays, as shown in Appendix T-3

#### 3-2.3.3.3 Control System Status

A. The Control System Status shall show the communication and operational status available for all subsystems that the TCCS interfaces to including the PLC’s, fire alarm control panel, communication gateways, and the traffic data stations. It shall include all information on the existing “PLC & Control Panel Status” display, as shown in Appendix T-3.

#### 3-2.3.3.4 Lighting System

A. The Lighting System display shall show the operational status and modes of the tunnel lighting control. It shall provide similar details to the existing “Lighting” display, as shown in Appendix T-3.

#### 3-2.3.3.5 Environmental Control Panel CP-1

A. The Environmental Control Panel CP-1 display shall show an elevation view of CP-1. As much as possible with the available data, it shall dynamically represent the actual state of all panel devices including switches, indicator lamps, the one line diagram of the power system, and carbon monoxide monitors.

#### 3-2.3.3.6 Annunciators

A. The Environmental Control Panel CP-1 and the existing console include alarm annunciators. The Annunciator Display shall emulate both of these annunciators. Mimic the behavior of the annunciators for the display of alarms with flashing and steady illumination of the alarms. Include Acknowledge and Reset control buttons that shall be effective for the alarms on these annunicators.

### 3-2.3.4 Control/Status Displays

A. Pop-up detail displays shall be included for each individual piece of equipment. Each pop-up detail display shall open when the user clicks on an equipment icon on the tunnel geographical or system displays. The display shall include all status, alarm and control functions available for that piece of equipment.

### 3-2.3.5 Alarm and Event Displays

B. A fully featured alarm and event message displays with filtering and sorting features shall be provided.

#### 3-2.3.5.1 Alarm Status

A. The display shall show all current alarms and all alarms that have been disabled by the operator. It shall include alarm management and control features to acknowledge, reset, and sort alarms by equipment group category. Alarm messages shall include time of alarm occurrence, equipment ID, alarm ID and alarm description.

#### 3-2.3.5.2 Alarm History

A. The display shall show all alarm activity in chronological order. Alarm messages shall include time of transition, equipment ID, alarm ID and alarm description.

#### 3-2.3.5.3 Event History

A. The display shall show the transition of all discrete points not defined as alarms including field inputs, field outputs, and operator initiated commands. Event messages shall include the time of transition, equipment ID label, point ID, point description, and on/off state. It shall include filtering capability to show the status of a single discrete point. Capacity of the event history buffer shall be at least 5000 state changes.

#### 3-2.3.5.4 Alarm Configuration

A. The display shall show all defined alarms sortable by alarm ID and/or equipment ID. It shall provide controls to activate and deactivate any alarm.

#### 3-2.3.5.5 Audible Alarm

A. TCCS shall sound an audible alarm through the Workstation speakers when there is a new alarm of at least a sufficient priority. The sound shall occur only for new alarms at the particular facility that the Workstation is selected for. The threshold priority level for audible alarming shall be configurable by a user with Configure privelege.

B. The audible alarm sound shall be configurable by a user with Configure privilege.

C. The audible alarm shall go silent after any alarm is acknowledged from the Workstation at which it is sounded.

#### 3-2.3.5.6 Alarm Conditions

A. Alarm conditions shall include:

1. Carbon monoxide levels
2. Detected and confirmed incidents
3. Power system changes
4. Fire Alarms
5. Telephone status changes to off-hook, on-hook, and trouble.
6. Fan and damper failures
7. Lighting failures, including failures to respond to commanded light levels
8. Traffic signal failures
9. Annunciator status changes

### 3-2.3.6 Tabular Displays

A. Tabular displays provide all TCCS system information that is organized in a columns and rows format.

#### 3-2.3.6.1 Traffic Data

A. For each traffic data station, TCCS shall display the volume, speed and occupancy data including the most recently polled data, 5 minute average, and 1 hour average by loop and by station.

#### 3-2.3.6.2 PLC I/O Status

A. TCCS shall display all discrete and analog I/O points from the PLC. The display shall be organized in tables by address order. It shall

include point description and current on/off state for discrete points or engineering value for analog points.

#### 3-2.3.7 Historical Trend Displays

A. The historical trend shall allow the user to plot any combination of up to eight logged analog data variables (such as CO levels, fan speed, etc.) for any arbitrary time period.

## 3-3 OPERATOR INTERFACE FUNCTIONS

A. This section defines the required functions that shall be available on the TCCS Workstations and other computers for the tunnel operators, maintenance staff, and system managers to monitor and control tunnel systems. The Contractor shall supply TCCS software that supports these functions.

### 3-3.1 Logon

#### 3-3.1.1 Display

A. TCCS shall show the currently logged user and the user's privilege type. On any one computer, there shall be only one currently logged on user.

B. TCCS shall show all currently logged on users on each TCCS Workstation or processor for the entire TCCS. For all computers, it shall indicate the logged on user and the privilege type.

#### 3-3.1.2 Control

A. Users shall be provided with a means to enter a user name and password to log on. This log on is for access privileges within the TCCS application displays and is independent of the log on for the Windows operating system.

B. Users shall remain logged on until a log off command is given. It shall not be necessary to enter a password to log off.

C. There shall be four types of access and each user shall be assigned to one of these types.

D. For the View type, all displays shall be available for viewing, but no control actions shall be functional.

E. For the Control type, all displays shall be viewable and all tunnel control actions, alarm activation/deactivation, and report requests shall be available.

F. For the Configure type, all displays shall be viewable and all System Manager functions shall be available, including adding and removing users or to make modifications to the way the TCCS functions.

G. For the Train/Test type, all diplays shall be available from the simulation of the tunnel control, and all trainer/tester controls of the simulator shall be available.

H. It shall be possible for a single user to be logged on at more than one computer in a facility or even all of the computers in the TCCS.

#### 3-3.1.3 Data

A. All user log on and log off activity shall be saved to the Event Log (see Section 3-3.2)

### 3-3.2 Alarm and Event Management

#### 3-3.2.1 Display

A. Alarms for the FHL and the MBT shall be segregated. That is, there shall be separate Alarm Status, Alarm History and Alarm Configuration displays for the two tunnels. Each of these shall display only the alarms for that facility.

B. TCCS shall show the alarm status on the icon or graphical element of the equipment associated with the alarm.

C. TCCS shall show status of all active alarms with color coded text messages on the Alarm Status display. Text messages shall include alarm ID, alarm description, priority level, and time of occurrence to the tenth second.

D. TCCS shall show all deactivated alarms on the Alarm Status display. Text message shall include alarm ID, alarm description, and priority level.

E. TCCS shall show a chronological log of all alarm activity with color coded text messages with alarm ID, alarm description, time of occurrence for all alarm status transition on the Alarm History display. The log buffer available at a Workstation shall contain the previous 1000 alarm transitions (including acknowledgements) for each tunnel.

F. TCCS shall show a comprehensive list of all alarms with alarm ID and alarm description on the Alarm Configuration display. The list of alarms shall be sorted by alarm ID or alarm description.

G. TCCS shall show a chronological log of all event activity with text messages with the data point ID, point description, discrete state, and time of transition. Events are defined to be any discrete point exchanged with a subsystem that is not an alarm.

### 3-3.2.2 Control

A. Users with Control privilege shall be able to acknowledge active alarms from the Alarm Status display or from any pop-up detail display that shows the individual alarm.

B. Users with Control privilege shall be able to reset alarms that have returned to the normal state from the Alarm Status display or from any pop-up detail display that shows the individual alarm.

C. Users with Control privilege shall be able to sort alarms on the Alarm Status display by alarm ID, time of occurrence or priority level.

D. When an alarm that is also on one of the control panel annunciators is acknowledged or reset, TCCS shall send a command to the initiating PLC to acknowledge the annunciators. Note that this is an existing function in the current system implemented by discrete PLC outputs to the annunciators and inputs to the PLC without computer involvement.

E. Alarm acknowledge or reset commands from one Workstation shall automatically acknowledge or reset the alarms on the other Workstations at all control rooms. Any acknowledge or reset command at one facility shall be reflected on the alarm displays at the other two facilities.

F. Operators with Control privilege shall be able to filter the alarms on the Alarm Status display to hide alarms below a selected priority level.

G. Operators with Control privilege shall be able to activate or deactivate any alarm from the Alarm Configuration display.

### 3-3.2.3 Alarm and Event Data

A. All alarm and event activity for a facility shall be saved to a chronological, ASCII text log file.

B. The log files shall be generated independently on each user interface computer at both tunnel facilities. At the Dayton Avenue Facility, the Historical Data Server shall log all alarm and event activity for both tunnel facilities.

C. The log file shall include the facility name, alarm ID, alarm description, time of occurrence to one-tenth of a second, and transition state for all:

    1. Workstation commands (all user inputs, including commands to devices and threshold settings)

    2. TCCS commands to external systems (e.g., digital outputs through PLCs)

3. External system status changes (e.g., telephone off-hook, CO level)

4. Device failures to respond to commands

5. System status changes (subsystem connection lost)

6. Software faults

D. There shall be a single log file for each day. The naming convention for log files shall be regular and easily recognizable.

E. The Workstations shall retain a minimum of the previous 90 days of alarms and events log files.

F. The Historical Data Server shall retain a minimum of four years of previous alarms and events log files.

## 3-3.3 Traffic Data

### 3-3.3.1 Display of Conditions

A. Traffic data stations (TDS) in the tunnel roadways collect volume, occupancy and speed data (VOS). This data shall be displayed on the Traffic Data Screens.

B. Display volume, occupancy, and speed data from TDS detectors and stations as a graphic representation of all tunnel roadways and as tabular data. (See existing Traffic Data Station Display in the appendix.) Display one minute rolling averages of VOS data.

C. Display operating status of each TDS per color sequences (see Appendix T-2).

D. Display the currently-used incident detection algorithms.

E. Display Traffic Direction Indicator for center lanes.

F. Display current global volume, occupancy, and speed color threshold key.

G. Display real time trend of VOS data.

### 3-3.3.2 Automatic Responses

A. The incident detection algorithms shall operate even though some TDS are not supplying data (offline). TCCS shall execute an incident detection algorithm which is (selectable by the user) either:

1. Based on one or more of the methods provided by Contractor software, OR

2. Based on the existing VAX-based system incident detection algorithm (as derived by the Contractor from source code provided in Appendix T-9).

B. A fan speed calculation algorithm shall adjust fans via PLC control based on traffic conditions. The TCCS shall implement the existing VAX/PLC fan control algorithm.

#### 3-3.3.3 Operator Controls

A. Workstation controls shall include:

1. Selection of display of speed, volume, or occupancy data

2. Activatation or deactivation (take offline) of individual Traffic Data Stations reporting.

3. Manual reset of the Traffic Data Station.

4. Confirmation or rejection of detected incidents.

5. Manual initiation or cancellation of incident indications for a tunnel segment.

#### 3-3.3.4 Algorithm and Parameter Selection

A. The user shall be able to select the incident detection algorithm and parameters to be used.

#### 3-3.3.5 Data Connection Schematic

A. See Traffic Diagrams (1) & (2) in Appendix T-2

### 3-3.4 Ventilation

#### 3-3.4.1 Display of Conditions

A. TCCS shall display ventilation conditions as follows:

1. Status of all ventilation system fans and controllable dampers.

2. Speed of all ventilation system fans.

3. Accumulated daily run times of each fan and log to SQL server.

4. Log of changes in fan operation, with start time, duration, speed setpoint, and actual speed at a settable sample rate.

5. The algorithm and parameters currently controlling fan speed.

6. Historical trend of running speed, power used and CO levels for user-selected fan, roadway, or system for a period of eight hours.

7. Detailed status of a selected fan, including data listed in Fans Diagrams 1 and 2 in Appendix T-2.

8. Condition(s) of the control algorithm that is currently causing fans to operate.

B. TCCS shall report historical fan operation, including total runtime and total revolutions and average usage, reporting on configurable periods including a month and a year.

#### 3-3.4.2 Automatic Responses

A. TCCS shall respond to CO level, traffic levels and fire conditions to select fan speeds and damper settings, and log the response.

#### 3-3.4.3 Operator Controls

A. Controls through the Workstation shall include:

1. Selection of individual fans or settable groups of fans for manual operation.

2. Selection of speed for manually-operated fans or settable groups of fans, with settable step rate limits.

#### 3-3.4.4 Algorithm and Parameter Selection

A. The user shall be able to select algorithm and parameters for ventilation system operation

#### 3-3.4.5 Data Connection Schematic

A. See the Fans Diagram (1) & (2), Appendix T-2

### 3-3.5 Signs and Signal Heads

#### 3-3.5.1 Display of Conditions

A. TCCS shall display Signal Head and Portal Sign status on the Traffic Overview

### 3-3.5.2 Automatic Responses

A. Initiate Signal Head and Sign settings to scripted condition in response to specified Fire Management conditions

### 3-3.5.3 Operator Controls

A. The user shall be able to initiate selected Signal Head and Sign settings

### 3-3.5.4 Data Connection Schematic

A. See the Signs Diagram in Appendix T-2

## 3-3.6 Power System

### 3-3.6.1 Display of Conditions

A. TCCS shall display the following for tunnel power system operation:

1. Current total energy consumption.
2. Geographic representation of the tunnel power distribution system, with breaker icons identification and status, transformer icons identification, bus work connections and energization status.
3. Representation of emergency generators, with icons indicating their status, and bus work indicating connections to the tunnel power distribution system.
4. Representation of Utility Power substation, with breaker status icons and bus work.
5. Utility switchgear status.
6. Tabular summary of breaker status for all breakers for the tunnel.
7. Tabular summaries of status of emergency generators, including over-speed, high temperature, low oil pressure, over crank, reverse power, low fuel, failure to synchronize, water, battery, and online/ offline status (availability).
8. Station battery status.
9. Station UPS status, including all measures available at the PLC.
10. Switchgear DC voltage alarms.
11. Transformer temperature alarms.

### 3-3.6.2 Operator Controls

A. Controls available through the Workstathin shall allow opening and closing a breaker, with confirmation.

### 3-3.6.3 Data Connection Schematic

A. See Power Diagram (1), (2) & (3) in Appendix T-2.

## 3-3.7 Tunnel Lighting

### 3-3.7.1 Display of Conditions

A. TCCS shall display conditions of the tunnel lighting system, including:

1. Icons providing identification and status of and measurements from the 8 photo sensors for lighting level adjustment in each tunnel. Four of these have been disabled.
2. Center roadway direction indicators
3. Lighting identification and status icons
4. Emergency light system status icon, bike path and roadway lighting control status and steps (where appropriate)
5. Facility utilidors lighting status

### 3-3.7.2 Automatic Responses

A. TCCS shall execute configurable time-of-day and step levels for automatic light level adjustment.

B. TCCS shall execute adjustment of lights for ambient levels.

C. TCCS shall set lighting to maximum level during a fire response.

D. TCCS shall automatically adjust lighting for center roadway direction.

### 3-3.7.3 Operator Controls

A. Controls through the Workstations shall include:

1. Enable and disable selected photo sensors (i.e., restore/remove from control of lighting)
2. Select the lights for each roadway for manual/automatic operation
3. Adjust output step of any selected lighting zone

#### 3-3.7.4 Algorithm and Parameter Selection

A. The user shall be able to:

1. Configure time-of-day and step levels for automatic light level adjustment
2. Configure thresholds and step levels for ambient light level adjustments
3. Select between time-of-day and ambient light level automatic control

#### 3-3.7.5 Data Connection Schematic

A. See Lighting Diagram in Appendix T-2

### 3-3.8 Fire Management

#### 3-3.8.1 Display of Conditions

A. TCCS shall display the conditions of the Fire Management Panel, with:

1. Geographic (approximate two dimensional) representation of three roadways
2. Fire zone identification
3. CCTV camera icons and identification
4. Telephone icons and identification and status
5. Local input/output processor (node) icons and identification
6. Center roadway direction indicator
7. Portal sign icon and status indicator
8. Fire zone alarm and pre-alarm conditions on fire screen
9. The association of fire zones to nodes

#### 3-3.8.2 Automatic Responses

A. TCCS shall initiate scripted CCTV control operations by alarmed fire zone and adjacent fire zones, based on alarm and pre-alarm.

B. TCCS shall monitor and display signal heads and signs conditions during zone alarms.

#### 3-3.8.3 Operator Controls

A. Controls through the Workstation shall include:

1. Enabling and disabling processing fire detector data or zone data.

2. Initiating CCTV control operations scripted by zone alarms (manually, from CCTV camera icons).

3. Overriding and restoring automatic controls of signal heads and signs.

4. Turning on and off signal heads and signs that are not in automatic mode.

#### 3-3.8.4 Data Connection Schematic

A. See Fire Diagram in Appendix T-2.

### 3-3.9 Carbon Monoxide

#### 3-3.9.1 Display of Conditions

A. TCCS shall display the carbon monoxide conditions, including:

1. Current CO levels for each roadway (east, center, west) at each monitoring point.
2. The trend of CO levels for a user-selectable period of up to 24 hours for CO monitoring points. The trend display shall allow panning across the period. Time scale and level scale shall be adjusted to match the current data.

#### 3-3.9.2 Operator Controls

A. Controls through the Workstation shall include enabling and disabling selected CO sensor status change alarming.

#### 3-3.9.3 Data Connection Schematic

A. See Carbon Monoxide Diagram in Appendix T-2.

### 3-3.10 CCTV and VCR

#### 3-3.10.1 Display of Conditions

A. TCCS shall indicate the geographic (approximate two dimensional) location of cameras and indicate which are fixed or movable and which cameras are currently selected for control and which workstation and users is controlling them

B. TCCS icons shall show geographically (approximate two dimensional) position of monitors and the camera assignment for each monitor.

#### 3-3.10.2 Automatic Responses

A. TCCS shall execute scripts during fire, incident, or telephone pickup conditions to select and position cameras.

#### 3-3.10.3 Operator Controls

A. Provide the following controls:

1. Select cameras and VCR/Digital Recorders to display on each of six video monitors per tunnel;

2. Interact directly with a selected (controllable) CCTV camera to pan, tilt, and zoom using Workstation mouse, joystick, or keyboard

3. Control of on/off and recording speed for each of VCRs (five at MBT and six at FHL).

4. Manage transfer of camera control from one workstation and/or user to another

5. Activate camera control scripts from a script library

#### 3-3.10.4 Algorithm and Parameter Selection

A. The Workstation user shall be able to create or edit sequences (list of cameras and dwell times) in a script library.

B. The Workstation user shall be able to create or edit scripts to pan, tilt, zoom, display and sequence CCTV cameras stored in a script library.

C. The Workstation user shall be able to associate or link selected scripts to specific fire, incident, or telephone pickup conditions.

#### 3-3.10.5 Data Connection Schematic

A. See Camera and VCR Diagram in Appendix T-2.

### 3-3.11 Reports

#### 3-3.11.1 Operations Summaries

A. TCCS shall print individual reports on demand (See Administrative Functions section)

### 3-3.12 Emergency Telephones

#### 3-3.12.1 Display of Conditions

A. TCCS shall display icon of telephone identification and status (off-hook, etc.) in a geographical (approximate two dimensional) representation.

#### 3-3.12.2 Operator Controls

A. TCCS shall enable and disable off-hook and on-hook and trouble status change indications.

#### 3-3.12.3 Algorithm and Parameter Selection

A. TCCS shall enable a Workstation user to link telephone pickup conditions with a CCTV control script.

#### 3-3.12.4 Data Connection Schematic

A. See Telephone Diagram in Appendix T-2

## 3-4 ADMINISTRATIVE FUNCTIONS

These functions shall be available

### 3-4.1 Reporting

#### 3-4.1.1 Operations Summaries

A. TCCS shall provide tools to create and edit reports and shall include the reports represented in Appendix T-5 as default.

B. TCCS shall provide tools for creating additional operations summaries.

#### 3-4.1.2 Operations Analysis

A. TCCS shall perform analysis and report of fan vs. CO level to identify overspeed or overcorrection and suggest parameter adjustments or algorithm usage.

B. TCCS shall provide tools for developing additional operations analyses.

### 3-4.2 Managing TCCS

A. TCCS shall provide support for a System Manager as described in this section.

### 3-4.2.1 Manage from Any Site

A. TCCS shall provide access to management functions from any properly configured computer on the WSDOT network.

### 3-4.2.2 Current Configuration Display

A. TCCS administrative interface shall display status of TCCS system components such as servers, workstations and other network equipment.

B. TCCS administrative interface shall display communications and hardware status of all subsystems and any alarms.

### 3-4.2.3 TCCS Configuration Definition Maintenance

A. TCCS shall provide easy-to-use tools to:

1. Add and remove devices and/or sensors to the existing TCCS system (to include all current types of devices and sensors)

2. Change value of all threshold paramaters (for example, CO levels, TDS color threshold, etc.)

3. Monitor and manage database disk and file allocations, and perform all database administration functions

### 3-4.2.4 System Configuration Management

A. The System Manager tools shall enable easy manipulation and update of off-line versions of configuration files, and easy activation of an off-line version set as the on-line set. TCCS shall allow the System Manager to:

1. Perform orderly system start-up and shutdown

2. Synchronize failover/restart/fallback of any site from any properly configured computer on the WSDOT network

3. Install new software version, including loading of new database

4. Rollback to previous software version, including restoration of database

5. Migrate data between database versions

6. Define and introduce new TCCS equipment of types already part of TCCS, such as communication equipment, Servers and Workstations (scalability)

7. View and edit complete definitions of field data connections such as PLC indication and control point names and addresses

8. Turn on or off any logged data that are intended for debugging and performance analysis, but are not essential for operation

B. The System Manager tools shall enable archiving complete system configuration to removable media and tools (including scripts) for rebuilding new TCCS system with such configuration. In addition, TCCS shall be able to create new install disks.

### 3-4.2.5 Workstation Display Maintenance

A. TCCS shall provide an integrated tool set to automate the generation and maintenance of the Workstation displays, including definition of the relationship between the external system data definitions and the TCCS window contents, and definition of colors and attributes for symbols and text.

1. It shall not be necessary to modify or compile software source code to perform such maintenance. Rather, such modification shall be possible through editing configuration data.

2. The tool set shall provide for display generation and maintenance using a graphics editor, and includes a user-friendly tool to automate the definition of icon attributes (such as color) for all Workstation displays.

3. The tool set shall provide tools for editing context sensitive help (including checklists) corresponding to the current activity.

B. TCCS shall provide tools for System Manager to create custom forms and reports using data from the TCCS database and make readily available to TCCS users at Workstations.

### 3-4.2.6 Alarm Maintenance

A. TCCS shall define alarm processing through a System Manager tool. Alarms and their reporting and processing characteristics shall be defined and maintained in the TCCS database. TCCS shall provide the System Manager with tools to fully define and update definitions for alarms. TCCS provides for the ability to change alarm priorities.

B. Alarm definition information shall include:

1. Conditions constituting an alarm

2. Corresponding visual indications for each device alarm

3. Timeout values for determining an alarm condition caused by a device failing to respond to control

4. The priority of each alarm

5. The text for each alarm

6. The sound file (.wav) that produces the sound for each alarm.

7. Attributes and symbol colors for each alarm and for unacknowledged alarms.

### 3-4.2.7 CCTV Scripts

A. TCCS shall provide a method to create scripts for display, pan, tilt, zoom and sequences (order and dwell), and associate with specific fire and incident conditions.

B. TCCS shall provide tools for management of a library of CCTV scripts.

### 3-4.2.8 Report Definition and Production

A. All TCCS databases shall respond to ad hoc queries, using Microsoft Access, of the TCCS operation, performance, and event logs.

### 3-4.2.9 Storage Archive/Retrieval

A. TCCS shall provide tools to backup, archive, restore and retrieve all TCCS data.

### 3-4.2.10 User Access and Privileges

A. TCCS shall provide the ability to edit, create and delete user accounts and set corresponding access and privileges.

B. TCCS shall provide the ability to define and add new user groups, with corresponding access and privileges.

### 3-4.2.11 Software Monitoring

A. TCCS shall provide System Manager tools to:

1. Monitor and control software process activity, and examine inter-task messaging, database activity, and field device raw data

2. View and troubleshoot the entire TCCS online.

#### 3-4.2.12 Equipment Diagnosis and Replacement

A. Contractor shall coordinate with WSDOT to provide:

3. LAN management tools to:

a. Maintain, monitor and administer LAN configuration

b. Monitor the status of the LAN nodes and the performance of the workstations and servers

c. Troubleshoot the LAN, workstations, and servers

B. TCCS shall provide System Manager tools to:

1. Perform equipment management tools to:

a. View equipment error messages for TCCS and subsystems

b. Initiate and report results of diagnostics on TCCS equipment and subsystems at user request

2. Logically remove and (re)introduce TCCS equipment that has failed or is undergoing maintenance.

### 3-4.3 Test and Simulation Tools

A. TCCS shall provide a Simulator to train tunnel operators, to test TCCS software functional changes, and to test TCCS against changes in tunnel configuration.

#### 3-4.3.1 Operation

A. The Simulator shall operate independently of on-going tunnel operations through a database structured identically to the on-line database and logs, plus any additional database as needed to manage its own operation (i.e. simulated data sources). The Simulator's operation shall not affect on-going tunnel operation or control.

B. The Simulator shall operate, and shall provide indications and control capability, based upon scripts of external events, as well as manual interjections of external events by the trainer or the tester during simulation operation.

#### 3-4.3.2 Training Mode

A. In training mode, the Simulator shall operate with a pair of Workstations as trainee and trainer workstations.

B. The Simulator shall accept starting conditions from recorded file (a initial conditions configuration file) and system conditions manually entered by the trainer.

C. The Simulator shall accept recorded and scripted events for devices and system, and allow commands to change their status during operation.

D. The Simulator shall simulate the entire tunnel system with realistic times and behaviors. For the trainee, simulated operations shall be consistent with normal device, tunnel, and traffic behavior, external events, and trainee commands.

E. The Simulator shall allow the trainer to pause, stop, start, reset and change the time scale of the simulated operation.

F. The Simulator shall allow the Trainer to view the Trainee display navigation, data entry, and command actions.

#### 3-4.3.3 Test Mode

A. In test mode, the Simulator shall operate with a pair of Workstations as tester and trainee workstations.

B. In test mode, the Simulator shall operate as in Training Mode section above.

C. In test mode, the Simulator shall produce event log files that are identical to, but independent of, the online TCCS log files and that can be accessed and analyzed using the identical tools to the online TCCS.

#### 3-4.3.4 History and Scripts

A. TCCS shall provide tools for capturing selected portions of status and logs of tunnel and control system activity and converting them into scripts for directing Simulator actions.

B. TCCS shall provide a tool for managing a library of Simulator scripts.

C. TCCS shall provide a graphically-based tool for editing scripts and creating scripts.

## 3-5 SUBSYSTEM COMMUNICATIONS INTERFACES

A. There are a number of tunnel subsystems that shall require particular communication interfaces with the TCCS. The "I-90 TCCS System Diagram" in Appendix T-1 shows the components of these interfaces in block diagram form. This diagram does not show the software components necessary for the TCCS to communicate with the various subsystems. The Contractor shall set up the communication software in a

redundant configuration, so that the failure of any one component shall not prevent the proper operation of the TCCS. The particular requirements and details of each subsystem communication interface are described below.

### 3-5.1 Programmable Logic Controller (PLC) Interface

A. The PLC system independently monitors and controls much of the tunnel equipment including all of the fans, carbon monoxide detectors, lighting, and the electrical power equipment. The TCCS has supervisory monitoring and control of this equipment through the PLC system. There are control switches, buttons and indication lamps on CP-1 (the existing panel that interfaces to the PLC's) that provide a manual interface to control equipment if the computer interface is unavailable. The PLC drives the alarm annunciators on CP-1 and the VAX-based tunnel computer system.

B. There are six PLC's in each tunnel. Two of these, PLC 5A and PLC 5B, run in a hot standby configuration. In the VAX-based system, the computer communicates directly only with PLC 5A and PLC 5B through two serial RS-422 cables. Currently, all data that is read and written from the VAX-based tunnel computer to PLC's 1, 2, 3 or 4 is passed from PLC 5A or 5B via the Sy/Net network.

C. The Contractor shall upgrade the communication with the PLC system to Modbus/TCP protocol via Ethernet using a Gateway. On the PLC side, the Gateway shall communicate with each PLC using the Sy/Max protocol via RS-422. On the Ethernet side of the Gateway all PLC interface data points shall be available for reading and writing using standard Modbus/TCP protocol.

D. Any device or software that interfaces with the hot standby processors, PLC 5A and PLC 5B, shall dynamically identify, display, and communicate only with the active, primary processor. If possible, this function shall be included in the PLC Gateway, causing the redundant processors to appear as a single processor to other devices on the network. However, it shall always be possible to program and configure all PLC processors via the Ethernet network and PLC Gateway.

E. Modification of the existing PLC logic or configuration shall not be required for TCCS to communicate directly to PLC's 1, 2, 3 and 4. However, the Contractor shall evaluate the existing PLC logic and configuration in order to identify all of the necessary interface data points. Interface points shall include all real discrete and analog I/O points as well as logical memory addresses necessary for all functions and display requirements.

F. PLC logic and cross reference files are available in Microsoft Word format in Appendix T-8. These files and the original PLC source code will also be available in electronic form. Further, the PLC input/output point lists are included in Appendix T-8, and are availabe in Microsoft Excel format.

### 3-5.2 Fire Alarm Control Panel (FACP) Interface

A. The fire detection and suppression systems are managed by an FACP in each tunnel. In the current system, the VAX-based tunnel computer communicates with the FACP through an RS-232 serial interface.

B. The Simplex 4100 protocol permits read and write access to the FACP. In this application, the FACP Gateway shall be configured to only read from the FACP. The Contractor shall identify all necessary data points available from the FACP's from the fire system documentation to support all functions and display requirements.

### 3-5.3 PABX Emergency Phone Interface

A. The existing emergency phone systems for both tunnels will be replaced under a separate contract in the same time period as the TCCS upgrade. The new emergency phone system will include a server that will provide all emergency phone status (on-hook or off-hook) for both tunnels. As shown on the "I-90 TCCS System Diagram" in Appendix T-1, this server will be located at the MBT Facility.

B. The application software on this server will be the Telephony Services Application Programming Interface (TSAPI) by Avaya. The messaging format and protocol will be per ECMA International Request for Comments 1305. The TCCS Contractor shall provide an Ethernet network connection to this server and shall develop an application on the TCCS to retrieve the status of the emergency phone system. The phone status information shall be provided to the Workstations emergency phone display. The Contractor shall coordinate with the phone system contractor for the development of this interface.

### 3-5.4 Traffic Data Station (TDS) Interface

A. In both tunnels there are two Bell 202 modems that communicate on 4 wire multidrop channels to the TDS's at 1200 Bps. The existing tunnel computers communicate with the modems via RS-232. There are ten TDS's in the MBT, and six TDS's in the FHL tunnel. WSDOT will provide new firmware for the TDS's. WSDOT will provide the protocol and the Contractor will implement the protocol in the TCCS. The TCCS shall:

   1. Poll the TDS every 20 seconds and store the VOS data and repoll, before the next cycle, any TDS that fails to respond.

   2. Archive the VOS data daily to disk in 5 minute summations for each detector and each logical station (logical station is defined as an aggregation of detectors). Store the data in the provided WSDOT NWR file format.

3. Use the WSDOT provided communication protocol for data collection, error retrieval, initialization, and configuration.

B. In the event of any shutdown, the daily VOS data file shall be recovered and missing data shall be flagged. Only the data during the shutdown will be lost.

C. The Contractor shall provide an interface to the each of the existing modems.

D. The Contractor shall provide a communication driver for polling all of the TDS's on each of the multidrop channels.

### 3-5.5 CCTV Controller Interface

In both tunnels the CCTV controllers interface to the existing tunnel computers through an RS-232 serial interface. The Contractor shall provide interface to the CCTV controllers. The end result shall be that any Workstation on the network shall be capable of controlling cameras and video switch functions. The FHL CCTV controller is by Vicon, and the MBT CCTV controller is by Cohu. These two controllers use different syntax in their ASCII command string protocols to control the cameras. Both protocols are completely documented in the controller manuals. The Contractor shall provide communication drivers for both controllers to support the required camera control functions. The interface shall be able to pan, tilt, zoom, focus and adjust iris on all cameras.

## 3-6 PERFORMANCE

### 3-6.1 Input Rates

A. The following scan rates and state change rates are anticipated for TCCS:

| **Type** | **Anticipated Rate** |
|---|---|
| Scan of Traffic Data Stations (each) | Once per twenty seconds for all quantities |
| Scan of carbon monoxide monitor (each indication point) | Once per five seconds |
| Scan Phone System | Once per five seconds |
| Scan PLC | Once per five seconds |
| Fire System status | Once per five seconds |

### 3-6.2 Response Times

A. Navigation among displays at a Workstation shall be in less than 500 milliseconds from user request.

B. Lag in updates of data from interfacing subsystem to Workstation interface shall be less than 500 milliseconds above the delays within the subsystems.

C. Lag in updates of trend data from interfacing subsystem to Workstation interface shall be less than 10 seconds above the delays within the subsystems.

### 3-6.3 Time Error

A. The time error at any Workstation or Server shall be less than 999 milliseconds.

### 3-6.4 Availability

A. The system availability requirement is such that TCCS succeeds in the Burn-In Test defined in Section 3-8.2.9.

## 3-7 DESIGN

A. This section defines specific design requirements for TCCS not otherwise covered.

### 3-7.1 Growth and Flexibility

#### 3-7.1.1 Size

A. TCCS shall have sufficient capacity such that the number of points in kind and in frequency of changes may be increased 100 percent without degrading its performance or requiring additional equipment.

#### 3-7.1.2 Addition of New Subsystems and Functionality

A. TCCS shall have the capacity, structure, and software tools to add interfaces to other subsystems and to add supporting functionality, including a Variable Message Sign Subsystem.

## 3-8 TESTING

A. This section specifies the testing requirements for TCCS. All test results are subject to approval by WSDOT before beginning the next testing phase. If the results of the test are unacceptable to WSDOT, the Contractor shall correct deficiencies and repeat the test.

### 3-8.1 Factory Functional and Performance Testing

A. Before shipping, TCCS shall sucessfully pass all factory tests to demonstrate functionality and performance. Complete factory test procedures shall be provided to the WSDOT Project Manager prior to the start of the factory functional and performance testing.

B. A complete functional audit shall be performed to show correct operation of all software functions. Equipment failures will be induced to confirm continued proper operation and functioning. Tests shall include:

1. Operation of all TCCS equipment, including operation with induced failures of TCCS equipment.

2. Functional interface testing, using real or emulated external systems, to other tunnel subsystems and equipment, and to other equipment provided under the Contract, including:

    a. Fire System

    b. Traffic Data Stations

    c. Closed Circuit Television and Video Cassette and Digital Recorder

    d. Traffic Signals and Signs

    e. CO Monitoring

    f. Fans and Dampers

    g. Lighting

    h. Power (Generator, UPS, etc.)

3. Operation of the Simulator, with multiple and varied WSDOT operating scenarios and conditions which includes the full TCCS configuration, to:

    a. Comprehensively test operation of the Simulator

    b. Verify TCCS configuration data

    c. Test proper operation of TCCS

4. Performance and response time on the TCCS central equipment. These tests will be performed using a simulated maximum workload, and will demonstrate the ability of the TCCS configuration to support the target system size and workload specified in Section 3-6.

C. Additional tests shall be performed to:

1. Successful burn-in of all equipment for at least 72 consecutive hours to test hardware functionality, and an additional 72 consecutive hours to test software functionality

2. Run diagnostic testing on all equipment

3. Run any additional testing recommended by the equipment manufacturers.

D. Signed factory test records showing successful completion of all factory test procedures shall be submitted to the WSDOT Project Manager for approval prior to a factory system demonstration.

## 3-8.2 Installation Testing

A. Upon field installation, the Contractor shall perform the tests described in the following subsections.

### 3-8.2.1 General

A. I-90 operates 24 hours a day. Diagnostic and functional testing will not be allowed to disrupt that operation. Interface testing, which may require disruption, shall be designed, scheduled and staffed to minimize disruption. Contractor will be allowed two complete, simultaneous closure of both tunnels from midnight to 4:00 am. Contractor may arrange for up to three additional closure periods at a Contractor expense of $10,000 each.

B. A repeat of the functional audit shall be performed on the TCCS equipment operating as one system.

C. Full Workstation operation shall be tested.

### 3-8.2.2 Diagnostic Testing

A. All equipment shall be inspected and tested for proper configuration settings.

B. Diagnostic tests shall be performed on all equipment.

### 3-8.2.3 Functional Testing

A. Functional testing shall be performed on the TCCS equipment. This testing shall verify all functions of TCCS equipment.

B. Test all Workstation and server Management screen and functions

C. Provide forms for documenting all test results

### 3-8.2.4 Comprehensive Interface Testing

A. Comprehensive interface testing shall be performed. This testing shall include comprehensive testing of all interfaces to equipment and systems not provided under the Contract.

B. Provide bit error level test results for all EIA 232, 422 and other communcation interfaces

### 3-8.2.5 Testing to Verify the System and Application Configuration

A. Comprehensive testing shall be performed to verify the system and application configuration data is complete and correct.

### 3-8.2.6 I-90 Tunnel Integration Testing

A. The Contractor shall perform integration testing to verify complete and fully functional operation of the TCCS with all elements of equipment that the TCCS interfaces with, both directly and functionally.

B. Integration testing shall be performed with the Dayton Avenue control facility and both the MBT and FHL tunnel control room facilities.

C. Integration testing that disrupts tunnel operation will be limited, as described above in section 3-8.2.1. The Contractor shall schedule testing accordingly.

### 3-8.2.7 TCCS Performance Measurement and Testing

A. The Contractor shall measure workload, response times, and equipment utilization levels in the working system for at least four non-concurrent one-hour periods. Elements measured shall include network equipment, Server hardware and software, all subsystems communication equipment, and Workstation hardware and software.

B. The Contractor shall provide WSDOT a report showing:

1. The measured workload and corresponding response times and equipment utilization levels.

2. The expected response times and equipment utilization levels when operating with a “target” system size and workload as defined in Section 3-7.

C. The test report is subject to WSDOT approval.

### 3-8.2.8 Conditional Acceptance Testing

A. Contractor in coordination with WSDOT shall run a conditional acceptance test on the TCCS after:

1. Contractor has installed all TCCS equipment and demonstrated its functionality and performance;

2. Contractor has successfully performed all required testing

3. Contractor has cut over interfacing systems and devices to connect to TCCS.

B. The test shall demonstrate operation of the I-90 Tunnel, as a whole, with the TCCS at MBT and FHL, locally and from Dayton Avenue for at least 72 consecutive hours without equipment or software failure.

### 3-8.2.9 Burn-In Testing and Final Acceptance

A. The Contractor shall run a Burn-In test for TCCS that demonstrates the stability of TCCS hardware and software. During the Burn-In period, WSDOT will use TCCS to operate I-90 Tunnel systems. The Burn-In period shall run for 180 consecutive days of successful operation.

B. TCCS shall have failed if any of the following occur:

1. There is more than one TCCS Workstation not fully-functional

2. TCCS is unable to communicate with any of the interfacing subsystems at either of the tunnels due to Contractor's equipment or software failures

3. Historical Tunnel data is unavailable

4. Any other TCCS function is unavailable.

C. The Contractor will not be allowed more than 48 total hours of scheduled downtime during the Burn-In period. WSDOT has authority to reject any downtime request.

D. The Contractor may at any time choose to halt the Burn-In period, identify and fix problems, and restart the Burn-In period from the beginning.

E. System downtime shall begin when designated WSDOT staff notifies the Contractor. Downtime shall end when Contractor has corrected the immediate problem and TCCS operation is restored.

F. The Contractor shall prepare and submit the Final Acceptance report for WSDOT's approval. It shall contain a summary of operation during the Burn-In, an accounting for System Downtime and a detailed description of the changes made to the TCCS during the Burn-In period.

## 3-9 INSTALLATION

A. The Contractor shall install the TCCS equipment according to an agreed upon schedule and design to accommodate an orderly transition to the new TCCS.

B. The following steps of Contractor work are anticipated:

1. TCCS equipment racks shall be installed at each control room.

2. New signal and power cables shall be run beneath raised floor (and in existing cable trays).

3. Holes shall be cut into floor panels to permit cabling for new Workstations. Holes shall be lined with appropriate protective material.

4. Workstations shall be placed on Contractor supplied tables and in temporary locations for use during training. Floor panels shall be relocated to permit cable access to these temporary locations.

5. After the Burn-In test is complete, the existing VAX-based control computer and its components shall be decommissioned and removed.

6. Existing consoles in MBT and FHL shall be decommissioned and removed.

7. Floor panels in the vicinity of the existing console shall be thoroughly cleaned.

8. Floor panels shall be rearranged to provide cable access to permanent Console and Workstation locations.

9. New Console shall be installed as indicated in the drawings in Appendix T-6.

10. Existing annunciator panel, fire panel, CCTV control equipment shall be installed in the new Console.

11. TCCS Workstation equipment shall be installed in the new Console.

## 3-10 CONSTRAINTS FOR INTEGRATION TESTING AND CUTOVER

This section identifies known constraints for Integration Testing and for Cutover. The Contractor shall work with these and investigate further constraints in developing the Cutover Plan.

A. Integration Testing and Cutover steps that involve testing of controls shall be performed only during periods of tunnel shutdown.

B. WSDOT will arrange for shutdown of both the MBT and FHL tunnels at the same time.

C. Times for shutdown will be 12 midnight until 4:00 a.m.

D. Schedules for a tunnel shutdown shall be made at least six weeks in advance.

E. No more than four WSDOT employees (required for the test periods) will be made available to cover the test sites.

## 3-11 TRAINING

A. This section identifies the training courseware and classes that the Contractor shall deliver for TCCS.

### 3-11.1 Training Scope

A. Training shall be provided for the following groups and numbers of trainees.

| **Trainee Group** | **Number of Trainees** |
|---|---|
| Tunnel Operators | 16 |
| Equipment Maintenance | 6 |
| System Manager | 4 |
| Simulator Users | 6 |
| Manager Briefing | 8 |

### 3-11.2 Training Plan

A. The Contractor shall develop a Training Plan that identifies:

1. A statement of the goals of each course

2. An overview of delivery methods for each course, including hands-on and group work experience

3. The training objectives for each course, each of which shall be measurable, shall include the conditions of measurement, and shall state the performance or level of success that must be achieved for each trainee

4. An evaluation plan, including criteria for success of the course, based upon the goals and objectives, and evaluation steps and instruments to be employed

5. A list of the equipment, tools and test equipment, manuals, and other materials to be used as trainee and trainer aids, including Simulator

6. A proposed schedule for each class, keyed to the installation process and constrained by availability of trainees away from regular duties

7. A description of the pre-requisite knowledge for each course. The Contractor may assume each trainee has worked in a similar role to that intended for the trainee

8. A plan for developing or customizing course material

9. Resumes of personnel proposed to be trainers for each class, demonstrating that they are experienced, effective training professionals

### 3-11.3 Training Materials

A. Course materials, including manuals, workbooks, job aids, lecture note sheets, handouts, situational (case study) and procedural audio and visual aids shall be of high quality. Course materials shall accurately reflect TCCS configuration and operation. Course materials become the property of WSDOT.

B. The organization and content of course materials shall be directed clearly to course objectives. There shall be no extraneous material. Material shall be organized into the order of presentation (except for reference exhibits). The language used shall be at a level that is appropriate for the particular training group, with concise statements and well-structured paragraphs. Terms shall be defined.

C. Course material shall be of uniform appearance and style, across documents (page layout, fonts, pagination) and within each class of material (quizzes, case studies, text, etc.). Page layout shall use high contrast and low density to enhance interest. Key points shall be highlighted. Graphics shall be used to support the content.

D. Course printed materials shall be assembled for accessibility for in-class and on-job reference, with tabbed sections and content-related labels.

E. Course supporting devices, including workbench tools and Workstation simulators shall match those to be used on the job.

F. Course test and evaluation instruments shall be included. These shall measure progress against objectives. They shall also measure trainees' response to environment, instruction quality, and content quality. Tests for pre-requisite knowledge, post-course, and on-the-job knowledge shall be included. The Contractor shall provide software tools for capturing and summarizing test and evaluation results. Test results shall be reviewed by the Contractor and WSDOT with changes made to the course material as indicated by this review.

G. The Contractor shall provide sufficient training materials for each trainee for each trainee group listed in Section 3-11.1.

H. The Contractor shall grant WSDOT the rights to record, edit, and use for its own purposes video recordings of training sessions presented by the Contractor.

### 3-11.4 Location and Schedule of Training

A. Training presentations shall be scheduled and located conveniently to or at WSDOT facilities and within WSDOT staff scheduling constraints.

B. Training shall be held within the 60 day period before the scheduled Conditional Acceptance.

C. Manager Briefings on TCCS operation (which will not require training materials as below) shall be held within 60 days of Final Design Review. WSDOT will develop or update tunnel operating procedures based upon these.

### 3-11.5 Instructor Materials

A. The Contractor shall develop and deliver an Instructor's Guide for each course. The Instructor's Guide shall be designed for use by experienced instructors, rather than subject matter experts in the course topic. Instructor's Guides become the property of WSDOT.

B. The Instructor's Guide shall show instructor and trainee material side-by-side, with the instructor portion containing time needed for each step and clearly described details of how to:

1. Present material
2. Lead group work
3. Run exercises and activities
4. Operate special equipment

C. Instructor's Guides shall contain supporting material beyond the material for trainees, including:

1. An explanation of the instructional and sequencing strategies
2. Identification of steps trainees typically have difficulties with, how to recognize those difficulties, and what to do to help.
3. Suggested questions and answers for discussions
4. Evaluation steps that demonstrate knowledge, comprehension, and application
5. Appropriate media for each step

6. Complete reproducible materials (and instructions as appropriate)

7. Containing checklist of materials and tools

D. The Contractor shall provide Instructor's Guides for each trainee group identified in Section 3-11.1.

## 3-12 DESIGN SUBMITTALS

A. The Contractor shall prepare and submit a number of design documents. Some of these are described in the subsections below. The rest of the documents are described in Section 4-9.

### 3-12.1 Draft Software Requirements Specification

A. The Contractor shall provide a draft of the Software Requirements Specification that shall include:

1. All functions, (including those for tunnel operators, System Managers, and Trainers);

2. All screens, screen layouts, navigation, and commands;

3. External Systems Interface Specification draft with all data definitions, including data for all communications

4. Definition of all database tables and file formats

5. Prototype workstation screens, and command sequences presented in the planned colors and on the type of TCCS monitor device to be used at the Workstations

B. The Contractor shall provide a two-way cross-reference mapping that shows the detailed mapping between all TCCS functions specified in these Technical Requirements and the corresponding sections of the Software Requirements Specification.

### 3-12.2 Preliminary Design Review Submittal

A. The Contractor shall provide a submittal for the Preliminary Design Review to WSDOT. This submittal shall be reviewed by WSDOT to verify conformance with the Specification requirements. WSDOT has the right to reject the submittal and require a new submittal and design.

### 3-12.2.1 Updates of Proposal Material

A. The Preliminary Design Review submittal shall include updates of the technical information submitted with the Proposal, as specified in Section 5.

### 3-12.2.2 Software Requirements Specification

A. The Preliminary Design Review submittal shall include the final version of the Software Requirements Specification, with the following additions to the draft Software Requirements Specification:

1. Completed Workstation screen layout (including data) and interaction definition

2. Final External Systems Interface Specification with all data definitions, protocol, and timing constraints definitions

3. Hardware and communication requirements related to all software functional requirements

4. Updated cross-reference mapping between the Technical Specifications and the Software Requirements Specification

### 3-12.2.3 Software Design Description

A. The Preliminary Design Review submittal shall include a draft Software Design Description. The Contractor shall submit a high-level Software Design Description that is based on IEEE 1016 Software Design Description, and shall conform to IEEE 1012 Verification and Validation. The initial draft version shall allocate the functions to software modules in the Software Requirements Specification and trace each function into the modules. The draft Software Design Description shall include:

1. Software structure charts for all custom application software, with definition of module functions

2. Allocation of software to hardware

3. Interfaces between application software and system software

4. Identification of data interfaces among modules

5. Top level data flow, transaction flow, and state transition diagrams for major application software modules and between application software and system software

6. Preliminary TCCS Data Dictionary

7. Definition of all major shared data structure

8. Description of all TCCS algorithms

9. Description of design decisions affecting the ability of TCCS to support continuing growth of the I-90 tunnel sub-systems

10. A two-way cross-reference mapping between all TCCS functions specified in the Software Requirements Specification and the Software Design Document

### 3-12.2.4 TCCS Equipment Preliminary Design Information

A. The Preliminary Design Review submittal shall include a TCCS hardware overview block diagram, with:

1. Identification and function of all TCCS equipment

2. TCCS equipment configuration detailed block diagrams, including allocation of functions, system software, and data to equipment

3. Layout of equipment for control rooms and consoles

4. Description of the physical connections between all TCCS equipment, and between TCCS equipment and equipment provided by others

5. Description of the physical and data link layers for each TCCS interface to equipment not provided under the Contract

6. Analysis of the TCCS hardware and software design, showing the expected response time and utilization given the target system size and workload specified, and showing the ability to meet the capacity requirements. This model will be subject to WSDOT approval. This approval does not release the Contractor from meeting the TCCS performance requirements based on actual measurements during the post installation testing. The information submitted shall include:

   a. **Performance** - Capacity, workload and response times

   b. **Maintainability and growth** - The ability and means to support changes in and growth of the TCCS

   c. **Availability** - The ability to continue operation in the event of a failure, and the ability to repair and restart failed modules/components without interruption to ongoing operation

#### 3-12.2.5 Manufacturer Data Sheets

A. The Preliminary Design Review submittal shall include data sheets for all major equipment and off-the-shelf software components.

### 3-12.3 Final Design Review

A. The Contractor shall provide a submittal for the Final Design Review to WSDOT. This submittal shall be reviewed by WSDOT to verify conformance with the Specification requirements. WSDOT has the right to reject the submittal and require a new submittal and design.

#### 3-12.3.1 Software Design Description

A. The Final Design Review submittal shall include a final Software Design Description with the following elements added to the draft Software Design Description. All other elements shall be updated as appropriate.

1. Top and second level data flow, transaction flow, and state transition diagrams for all application software and between application software and system software

2. Final Data Dictionary

3. Module performance requirements

4. Module test requirements

#### 3-12.3.2 TCCS Equipment Final Design Information

A. This information shall include the precise physical configuration (such as equipment and rack placements, rack layouts, data and power cable paths and connections, etc.) of the TCCS equipment.

## 3-13 SOFTWARE AND USER DOCUMENTATION

### 3-13.1 Operator and Maintenance Manuals

A. The Contractor shall deliver operator and maintenance manuals for TCCS as described below.

#### 3-13.1.1 General

A. Operator and maintenance reference manuals shall be provided.

B. These manuals shall be customized as needed to provide all of the material needed for the intended audience without extraneous material.

C. These manuals shall be provided in hardcopy as indicated in Table 4-1.

D. These manuals shall be provided on CD-ROM in one or more of the following machine-readable formats, in current versions or as specified, as appropriate to the type of material:

- Microsoft Word
- Microsoft Excel
- Microsoft Visio
- Microsoft PowerPoint
- Bentley MicroStation V8

### 3-13.1.2 Equipment Maintenance

A. Manuals shall be provided that cover tools and techniques to monitor system and device performance, perform all tasks, troubleshoot problems, and replace equipment components.

### 3-13.1.3 Tunnel Control Operation

A. Manuals shall be provided that describe in detail the purpose, content, and methods of Workstation screens and input devices. It shall incorporate operating policies and procedures made available by WSDOT.

### 3-13.1.4 Simulator Use

A. Manuals shall be provided that describe in detail the operation of the Simulator for training and for testing, and the creation and management of training scripts.

### 3-13.1.5 System Management

A. Manuals shall be provided that contain comprehensive instruction on System Management functions related to TCCS applications and configuration.

B. Subjects covered in these manuals shall include:

1. Configuring and defining the system and displays using the TCCS database and configuration tools

2. For each subsystem interface, troubleshooting the physical and logical interface, and stopping and restarting TCCS management of the interface

3. Defining TCCS users and administering their access privileges

4. Accessing the databases using the database toolset

5. Restoring all Servers

6. Understanding and taking action on, in the context of the TCCS configuration, TCCS error messages and other fault indications

7. Starting and stopping TCCS

8. Any other management task

#### 3-13.1.6 Software Operations and Maintenance

A. Software operations and maintenance manuals shall be provided for all equipment and for all system software. At least four manuals shall be provided for each unit (e.g. each printer, each data communications server, each LAN hub, etc.) of TCCS equipment, and at least four manuals shall be provided for each copy of licensed software.

### 3-13.2 Software Design Description - Final

A. The Contractor shall include in the final version of the Software Design Description:

1. Pseudo-code or program design language

2. Test facilities needed

3. Test procedures

4. Test facilities software

5. Source code and data

6. Test results

7. Module building and loading scripts

END OF SECTION 3